Los Angeles County Arterial Intelligent Transportation System (ITS) Inventory and Architecture Project

Deliverable 15
Arterial ITS Executive Summary

Submitted to:

Metro
Los Angeles County
Metropolitan Transportation Authority

Submitted by:

Meyer, Mohaddes Associates
a business unit of Iteris, Inc.

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Introduction
The purpose of this document is to summarize the approach for the Los Angeles County Arterial Intelligent Transportation Systems (AITS) Architecture development as well as its key findings. The first part of the Executive Summary briefly outlines the project's overall goals and objectives, defines the most important project parameters, and then describes those tools utilized to produce the results. This document concludes with presentation of some of the key results.

This project met its overall objectives, specifically to: provide a complete inventory of arterial ITS projects within Los Angeles County; develop the AITS architecture consistent with FHWA Regional Architecture guidelines; and, integrate the results with the Regional Integration of ITS (RIITS) project. The AITS Architecture will serve as a baseline, and will be updated periodically to incorporate future ATIS systems and ITS projects within Los Angeles County. Therefore, the Los Angeles AITS Architecture project has provided a road map for development and implementation of future AITS projects with the Los Angeles County.

Under the leadership of MTA's South Bay Area team and the stakeholders with AITS projects within Los Angeles County, the Project Steering Committee (PSC) was formed at the beginning of the project. The PSC facilitated consultation and building consensus among the stakeholders, and greatly contributed to development of the AITS Architecture. The PSC meetings provided an environment which promoted communication and cooperation among participating agencies.

At the completion of this project, the PSC will transition to the AITS Configuration Management Committee (CM) which will be responsible for maintaining the AITS Architecture, and interaction and communications with other regional projects such as RIITS. The ATIS CM Committee will operate as a subcommittee to RITTS and an MTA representative will participate in the RIITS CM Committee.

As part of this project, a web based GIS map was developed which facilitates visual representation of ITS projects and systems within Los Angeles County. This tool will be very useful in planning future AITS projects. Once inventory data of ITS elements (such as CCTV, CMS, etc.) have been entered into this map, MTA envisions providing access to this information for agencies within the Los Angeles County.

Project Background & Goals
The Los Angeles County Metropolitan Transportation Authority (MTA) completed the Arterial Intelligent Transportation System (AITS) Inventory and Architecture project in late 2004. This project's goals included:

- Obtaining a complete inventory of AITS projects in Los Angeles County that have been funded, constructed, or implemented since the 1993 Call for Projects, irrespective of funding sources.
- Utilizing a tool called Turbo Architecture™ (Turbo) to develop a complete AITS Architecture for Los Angeles County.
- Fully integrating the results of the AITS Architecture with that of the Los Angeles County Regional ITS Architecture produced through the Regional Integration of ITS (RIITS) Project.

The Federal Highway Administration (FHWA) and the Federal Transit Authority (FTA) requires all ITS projects funded from the Highway Trust Fund (i.e. federal funds) to conform to the National ITS Architecture and appropriate standards in order to foster regional integration. This project meets this requirement for Los Angeles County.

National ITS Architecture
The National ITS Architecture is a mature product which provides a common framework for planning, defining and integrating ITS. The National Architecture defines the functions required for ITS, the subsystems where these functions reside (e.g., a center, the field, or the vehicle), and the information and data flows that connect these physical subsystems into integrated systems.

Timeframe, Locale, and Stakeholders
Developing the AITS Architecture for Los Angeles County began with a focus on three parameters: timeframe, locale and stakeholders.

1. A 10-year *timeframe* was established because this window is sufficient to include most of the system integration opportunities that can be anticipated by the County's stakeholders.

2. *Locale* includes all of Los Angeles County (i.e. 89 jurisdictions encompassing 88 cities and the County of Los Angeles).

3. *Stakeholders* are defined as agencies that own and/or operate AITS or have an interest in arterial transportation issues. Stakeholders were divided into the following two groups for this project:

   - Project Steering Committee (PSC): The project "champion" is composed of a core set of public agencies with transportation-related responsibilities and/or duties in the Los Angeles County area. Steering Committee participants include: the Los Angeles County Metropolitan Transportation Authority (MTA) which served as Project Chair; Caltrans District 7; the Cities of Burbank, Downey, Glendale, Inglewood, Long Beach, Los Angeles, Palmdale and Pasadena; FHWA – Los Angeles Regional Office; Los Angeles County Department of Public Works (LACDPW); the Ports of Los Angeles and Long Beach; and, the Southern California Association of Governments (SCAG).

   - Individual Stakeholders: The balance of the cities in the County.

Tools Utilized
Two tools or systems have been used to organize the AITS inventory. The inventory collection process provides input for both purposes simultaneously.

   - *Turbo* is a software application developed by the FHWA that can be used as tool for ITS planners and system integrators to develop regional and project architectures using the National ITS Architecture guidelines. Raw inventory data, using data input requirements and system naming conventions, is the input into Turbo.

- *ArcView* is a software tool to graphically display information on a map. It is an off-the-shelf Geographic Information System (GIS) software product that provides location-based data creation, management, integration and analysis.

Approach

Development of this AITS Inventory and Architecture was a highly cooperative effort led by MTA, and involved the full and ongoing participation of a core Project Steering Committee made up of various agencies and jurisdictions in Los Angeles County. The successful culmination of the AITS project will spur the formation of the AITS CM Committee that will continue the work of this project in the years to come as Los Angeles County progresses towards interoperability of transportation systems and interchangeability of devices. It will further provide a forum for stakeholders to continue to share and exchange information and ideas.

The intent of the Los Angeles County AITS is to provide guidance, and act as a resource, for development of AITS projects. This document summarizes development of a complete inventory of AITS projects in Los Angeles County using the following eight steps:

1. Market Packages

The first step is selection of Market Packages that correspond to the user's ITS needs and services. AITS needs and services are identified using interviews and research from existing documents.   Market Packages are comprised of one or more subsystems, and provide deployment-oriented services from the National ITS Architecture framework that responds directly to those needs.

2. Operational Concepts

Market Packages are used to identify and select Operational Concepts that would meet identified needs. An Operational Concept, when applied to transportation management and operations, is a strategy for achieving a shared set of expectations and the delivery of services to be provided by a regional transportation system. These expectations are typically identified by system operators and managers in response to local and regional needs. Operational Concepts focus on the functions of people and agencies.

3. AITS Functional Requirements

Functional Requirements focus on the systems and what they are required to do to accomplish the AITS objectives. Functional requirements, by definition, are identified by "shall" statements.

4. Type of Agency Agreement

The institutional framework for the deployment of AITS involves coordination between various jurisdictions and agencies to achieve seamless operation and/or interoperability.   These connections usually require some form of agreement (either formal or informal) to define the roles and responsibilities of each party.

There are various types of agreements to support AITS integration. A simple handshake agreement may be enough for some activities, but, once system interconnection and integration begins, agencies may want to have something more formal in place. Formal agreements run the gamut from: a Memorandum of Understanding; Interagency, Intergovernmental and Operational Agreements; and, Funding and Master Agreements.

A documented agreement will aid Los Angeles County cities and agencies in planning their operation and maintenance costs, understanding their respective roles and responsibilities, as well as building upon working relationships for future projects.

5. Interconnect and Information Flow Diagrams
The four previous steps provide the groundwork for evaluating which AITS systems should connect to each other. Based on this information, a set of connections is identified, and then the types of information that will be exchanged between the systems are defined.

Turbo provides a standardized list of possible information flows that could be exchanged between the specified systems, and facilitates selection or elimination of information. Once connections and flows are defined, *Interconnect and Flow Diagrams* for each agency are generated using Turbo.

- *Interconnect Diagrams* graphically depict the various systems in a region that are connected to other systems and show how a particular element within an ITS architecture interconnects to other elements in the regional architecture.

- *Information Flow Diagrams* graphically depict the type of information flowing between the connected systems, and represent the next level of detail to the Interconnect Diagram.

The definition of each data flow has been standardized through the National ITS Architecture™.

Figure 1 on the following page is a high-level conceptual diagram for the Los Angeles County AITS Architecture. This diagram was derived based on the inventory analysis, the local approach to interconnection, and an understanding of stakeholders needs.

6. Standards Definition
One of the fundamental goals of the United States Department of Transportation (USDOT) is to establish an open and interoperable ITS environment by defining standards for information flows. The National Transportation Communications for ITS Protocol (NTCIP) standards makes possible the interoperability of transportation systems and interchangeability of devices using standardized features.

ITS standards specify how different technologies, products and components interconnect and interoperate so that information can be shared automatically. They facilitate deployment of interoperable systems at local, regional and national levels without impeding innovation as technology advances and new approaches evolve. Establishing regional and national standards reduces development risk and cost since a region can select among multiple vendors for products and applications. Standards also create competition, better products and lower prices.

Los Angeles County should create a plan to migrate toward ITS standards conformance. Stakeholders will first have to reach consensus on an interim approach as many ITS standards applicable to the region's interfaces are not yet mature. At this juncture, applicable standards for the Los Angeles County AITS have been selected using Turbo. Recommended standards for Los Angeles AITS are the Center-to-Center and the Center-to-Field standards, as well as those standards applicable to incident management.
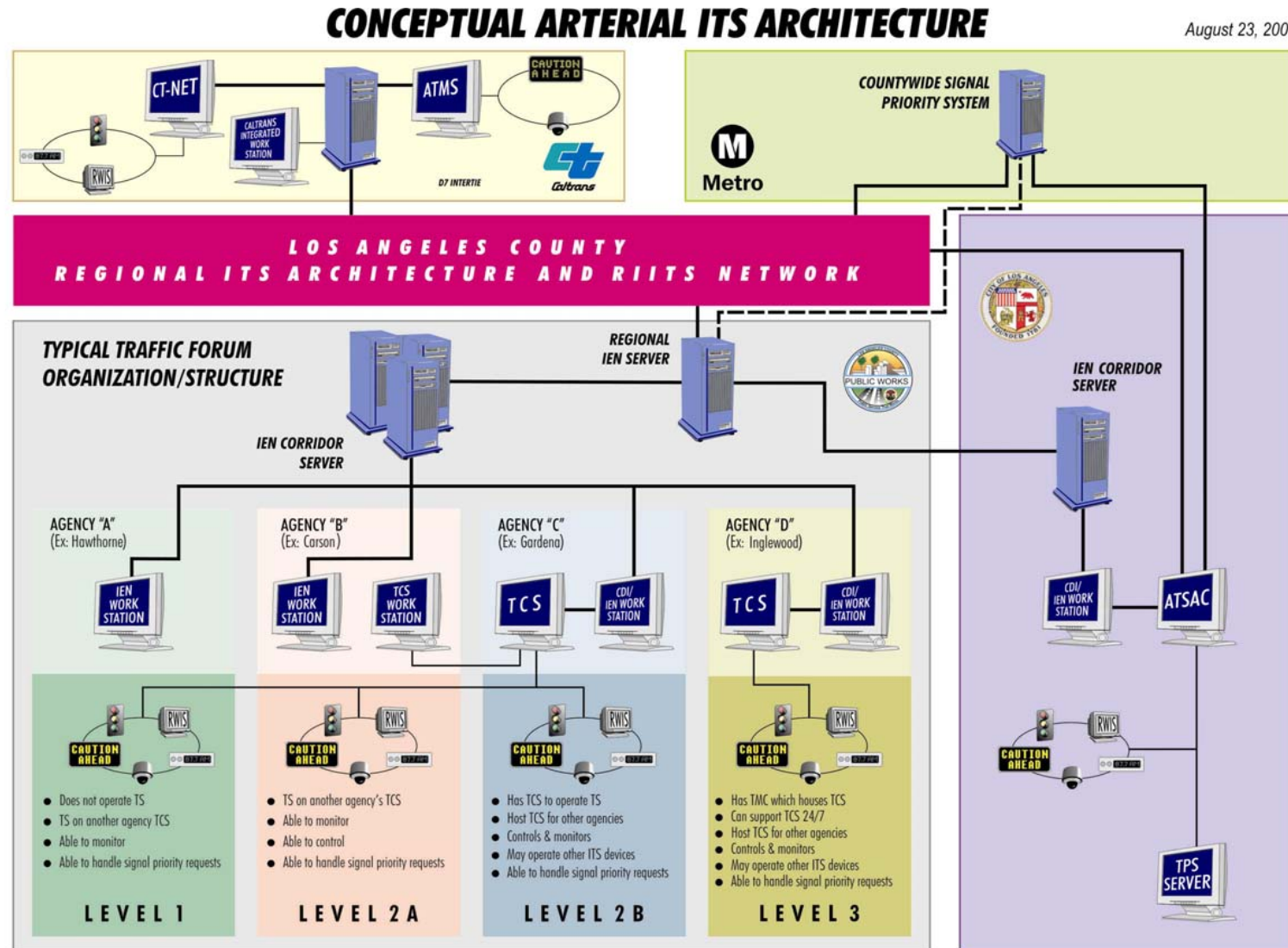
Figure 1 – Los Angeles AITS Conceptual Diagram

• Meyer, Mohaddes Associates

- The *Center-to-Center* standard (NTCIP C2C) involves the communication between two or more central management systems. The Los Angeles County AITS includes The County of Los Angeles Department of Public Works' Information Exchange Network (IEN) Corridor Servers that allow traffic management centers to share and exchange information to manage and coordinate traffic.

- The *Center-to-Field standard* (NTCIP C2F) involves the communication between a management system or a center, and multiple control or monitoring devices managed by that system or center. This type of communication typically involves roadside devices such as traffic signals, changeable message signs, etc. The Center-to-Field standard addresses primarily the interfaces between a TMC, the ITS field devices it manages, and other TMCs. They provide both the rules for communicating (protocols) and the vocabulary (objects, data elements, and/or messages) necessary to exchange information between ITS systems.

- *Other applicable National ITS standards* are those associated with incident management. By following national incident management standards a true multi-agency response to an incident is more easily implemented. Applicable standards include:
    - The ITE/AASHTO Advanced Traffic Management Data Dictionary (TMDD) that provides a common definition in system engineering terms of data in a typical ITS element.
    - The IEEE P1512 Message Sets for Incident Management which is a suite of standards that enables TMCs to track in detail the on-site management of an incident.
    - NTCIP 1402 Transit Communications Interface Protocol - Incident Management (IM) Business Area Standard which tracks an incident from the point of view and needs of the transit agency.

7. Project Sequencing

The goal of the AITS Architecture planning process is to use local knowledge and a consensus building process to determine the logical sequencing of projects to create a transportation network that best meets the needs of the region. Translating this goal to the Los Angeles County AITS Inventory and Architecture project results in the following objectives:

- To create a comprehensive list of AITS projects.
- To build the AITS architecture.
- To fill system gaps based on regional needs, project readiness and capacity.
- To build consensus around the defined project sequence.

To move forward in the actual sequencing of projects, each project has been assigned a relative priority, designated as High (1), Medium (2) and Low (3). Therefore, there are groups of "High (or short term)", "Medium (or medium term)" and "Low (long term)" priorities rather than a specific priority ranking for all of the identified projects. This approach is desirable in that it does not identify "Project A" as being a higher priority than "Project B", thus potentially pitting one project or agency against another when competing for funding.

The overall approach in sequencing the Los Angeles County AITS projects is to implement the infrastructure for sub-regional TMCs. The project priorities have been assigned and the PSC based on two primary factors — the need for a particular AITS function and a logical ordering of

projects. Project sequencing also takes deployment timelines and dependencies into account. The prioritization of projects should be used as a guide, and not a prescription, for funding.

Some of the AITS deployments already exist or are underway in the Los Angeles County area. The full deployment of the AITS Architecture will be implemented through many individual public ITS projects and private sector initiatives over the next several years. A list of implementable ITS projects as identified by the PCS are generated in this step of the AITS Architecture development and are included in the Final AITS Architecture Report.

<u>8. AITS Architecture Maintenance</u>
As AITS projects are implemented, the AITS Architecture will need to be updated to reflect new AITS priorities and strategies that emerge through the transportation planning process.

The parts of the AITS Architecture that need to be maintained are referred to as the "baseline" architecture which includes: description of the region; list of stakeholders; operational concepts; list of ITS elements; interfaces between elements; system functional requirements; applicable ITS standards; and, project sequencing.

Modification to the AITS Architecture may be brought about by: changes in regional needs; emergence of new stakeholders; changes to project (element) scope of services; alteration in stakeholder or element names; and, changes in other architectures such as the RIITS project architecture. There are also several changes relating to project definition that will prompt the need for updates to the AITS Architecture including project definition or implementation, project addition/deletion, and/or priority.

Just as the PSC was key in the development of the Los Angeles County AITS Architecture, it is imperative that stakeholders stay involved in its on-going maintenance. As such, it is recommended that the original PCS representatives or a subset of the group form the AITS Configuration Management (CM) Committee with MTA continuing to take the lead.

It is also recommended that the main output of the Los Angeles County AITS Architecture should be updated once every three years to coincide with the Regional Transportation Plan (RTP) planning process. The operational concepts, system functional requirements, project sequencing list and the list of agency agreements represent high-level views of the AITS Architecture, and will be modified as the architecture is broadened to address new needs and services or as new stakeholders are added.

The RIITS project supports information exchange in real-time between freeway, traffic, transit and emergency service agencies to improve management of the Los Angeles County transportation system. The AITS Architecture maintenance plan is a subset of the RIITS maintenance plan and it follows similar steps as the RIITS architecture maintenance process. The maintenance plan describes how changes are identified, reviewed and implemented. The following process can be used to complete an update the AITS Architecture.

A stakeholder can **identify** a change in the AITS Architecture and submit a change request to the ATIS Maintenance Committee for review and **evaluation**. Each change request needs to be evaluated to determine what impact it has upon the architecture baseline. The next step is to **approve**, defer, or reject the change request. **Updating** the baseline involves bringing the AITS Turbo database and documentation current. If there are significant changes to the AITS, the updates can be performed once a year or at different intervals as deemed appropriate by the

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Identify

Evaluate

Approve

Update

Notify
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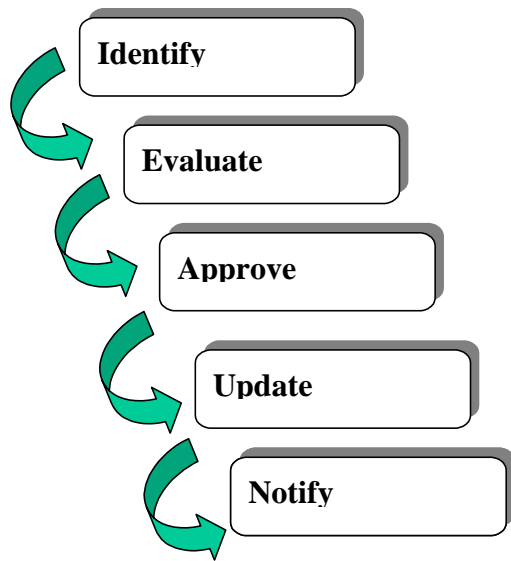
Committee. The final part of the maintenance process is to **notify** stakeholders of the changes or updates to the AITS Architecture.

Lastly, it is recommended that MTA leads the AITS CM Committee, and participates in the RIITS Configuration Management Committee (CM) to facilitate communication and to help coordinate activities between the Los Angeles AITS Architecture and RIITS Architecture. The AITS CM Committee will be a subcommittee to RIITS CM. The AITS CM Committee member will be responsible for facilitating communication between the RIITS and AITS CM, notifying either of changes that would affect their respective architecture.

Conclusions

Through the Los Angeles County AITS process, a full inventory of projects implemented and/or funded in the region over the last decade has been prepared. In addition, a detailed AITS Architecture for the County has been developed using the Turbo software tool. The results of this project have been integrated into the RIITS final report, and the AITS CM Committee will continue to work closely with RIITS to exchange AITS information.

The Los Angeles County AITS Inventory and Architecture project has led to the establishment of a framework for developing future AITS projects in the region by applying a system engineering process utilizing National and Turbo Architectures. The AITS inventory, requirements, operational concepts, system interfaces and future projects to date have been identified.